(54) Title: MULTI-LEVEL RADIO-FREQUENCY COMMUNICATION SYSTEM

(57) Abstract

A digital data communication system enables host computer to communicate with a great number of data terminals having specified functions. Communication from the host computer proceeds through a medium or long distance, high power transceiver and through a multiplex system to one of a number of portable communication devices. The communication devices preferably contain internal power supplies, such as rechargeable NiCad battery packs. The devices may be carried on a person's belt, or may be mounted within or on a service vehicle, for example, a forklift truck for use in warehouse operations or a merchandise delivery route vehicle. The communication devices are adapted to function as communication relay devices between the host computer and selected ones of the data terminals. Each communication device includes a first type, low power transceiver to communicate within a first channel and at a low power transmission level with a selected number of data terminals which also feature such first type transceivers. A communication device further includes a high power transceiver to communicate within a second channel with the transceiver of the host computer. A microprocessor operated address controller allows the communication device to control low power communication among the data terminals by receiving and re-transmitting locally directed communications. The controller and the controlling protocol further relays data messages between the low power communication level and host computer. In operation the device receives data messages on one of the transceivers and transmits them on the other. The communication device further may contain sufficient memory capacity to permit periodic batch type data transmission between the host computer and the communication device. The ability to switch from a high power, high precision and high cost transmission system to a low power, low precision and low cost transmission system at the level at which a great number of data terminal devices are used provides system flexibility at a reasonable cost.

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MULTI-LEVEL RADIO-FREQUENCY COMMUNICATION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates generally to mobile data
5 communications systems and more particularly to data
communications systems in which a radio link is
established between a central computer or data processing
station and a plurality of selectively addressable
communications substations.

10 2. Discussion of Prior Developments

The prior art has developed to a state in which
radio links between a central computer as a central data
processing station and a plurality of substations is
becoming well established in the art. Portable, hand held
15 data terminals are coupled via RF (Radio Frequency)
wireless data links to a transceiver and a multiplexing
station and such a central processing station. The hand
held data terminals are used, for example, for restocking
merchandise items, thus, in the larger sense for real
20 time inventory control and pricing of merchandise items.

In a currently pending patent application by
Miller et al. entitled "Transaction Control System

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Including Portable Data Terminal and Mobile Customer
Service Station", U.S. Serial No. 07/345,146, filed April
28, 1989, and assigned to the assignee of the present
invention, at least one of the hand held data terminals is
5   replaced by a portable customer service station which may
include multiple components which are selectively
addressed by the central processing station to print
customer information at the portable customer service
station, based on data inputs received from one or more of
10   the hand held data terminals in the disclosed transaction
system.

         Other uses of centrally controlled operations
relate to improvements in the delivery or service route
business.   In operations relating to delivery service, a
15   delivery vehicle may contain a printer module which is
mounted within the vehicle and which either may be powered
by the vehicle or it may be battery powered and, hence,
self-contained. The printer module may have associated
therewith a terminal cradle such as is disclosed in a
20   patent application of Phillip Miller et al., filed on
January 31, 1989, Serial No. 07/305,302, entitled "Vehicle
Data System", assigned to the assignee of the current
invention. A hand held data terminal may be inserted into
the cradle. The insertion of the terminal communicatively
25   couples the terminal to the printer to enable the terminal
to transfer data to the printer. This type of operation
allows the route driver to use the hand held data terminal
to complete a transaction at a customer's premises, enter
a record of the completed transaction into the terminal,
30   and use some of the entered information of the transaction
record in a data transfer to the printer module to
generate a printed invoice or waybill to present to the
customer on the spot for acknowledgment and for the

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customer's records. The data terminal in such an
operation may be of a batch type, in which the data
terminal retains all transactional information
regarding a plurality of deliveries in self contained
5   memory, until the delivery route has been completed. At
this time the collected data may be transferred from the
data terminal via a hard-wired data link to a central
processing station.

The referred to copending application of Phillip
10 Miller et al. further discloses a vehicle data system
which expands the use of the hand held data unit to
address a plurality of data devices which may be
selectively installed and used in a service vehicle. The
system may include at least one hand held data terminal
15 which may be temporarily removed to gather data from
outside of the vehicle, in a manner similar to that of
the delivery route operation. As a particular example, a
forklift truck is disclosed as a vehicle the operation of
which is being advantageously affected by the vehicle data
20 system. Through the data system an operator of the
forklift vehicle may receive operating instructions on a
real time basis. Each of the plurality of data devices
may be selectively coupled via a vehicle-resident local
area network (LAN) to other data devices as addressed, for
25 example, by a LAN controller. The referred-to copending
application further discloses a portable hand held data
terminal which may contain programming to act as the LAN
controller and may be removably received in a mobile mount
adapter of the vehicle LAN. Alternatively, an RF modem
30 may be coupled to the LAN and contain the network
controller and further couple the LAN data bus with a
stationary host central data processing station. The RF
modem would be able to periodically supply data from the

hand held data terminal and from various other LAN-coupled
data terminals or measurement devices to the host station.
Similarly, the host station may supply data to a data
terminal, such as a printer as needed.

5   The above-described system of the Phillip Miller
et al. patent application includes a further enhancement
in that any of the described data terminals, such as
vehicle operation measuring gauges or the vehicle mounted
printer, are selectively coupled to the LAN only when
10   fully functional, and are otherwise not recognized as
being present as part of the LAN. Though more flexible
than state of the art fixed device installations, the
operational flexibility of such a system is limited by the
configuration of the LAN installed in the vehicle. Data
15   terminal adapters for a predetermined number of data
terminals or peripherals must be configured to allow the
system to serve a particular need. Even though vehicle
LAN systems for the predetermined number of data devices
are known to simplify wiring of the vehicle, the desired
20   flexibility permitted under the disclosed vehicle data
system would again increase the complexity of locating
data terminal adapters to selectively include various data
terminals.

SUMMARY OF THE INVENTION

25   It is therefore an object of the invention to
provide a portable data system with the ability of being
selectively enhanced without a need for pre-installed
wiring to support any such selective enhancements.
           It is an additional object of the invention to
30   provide for selective placement of data terminals within a
functional environment of a LAN controller without the
need for a plurality of pre-installed data terminal

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adapters to receive such data terminals at any selected
location relative to the LAN controller.

It is a further object of a particular aspect of
the invention to provide versatility to a mobile LAN, such
5   as a vehicle-resident LAN, to enable data terminals to be
selectively added and repositioned without requirements
for changing the wiring of such mobile LAN.

It is yet another object of the invention to
provide a portable, hand held data terminal which permits
10 scanning, display of data, printing, communication to a
remote host computer or central data processing station,
and other functions without an increase in size relating
to such a diversity of functions.

It is still another object of the invention to
15 provide a means of wirelessly communicating between a
portable hand held data terminal and a plurality of
peripheral devices dedicated to such portable hand held
terminal.

In accordance with the present invention, a
20 mobile communications system includes a dual RF
transceiver communication device and has a first type RF
transceiver means and second type RF transceiver means.
The first type RF transceiver means is operative to
transmit and receive first type RF signals for
25 communicating with at least one of a plurality of first
type data devices. Each data device includes a first type
RF transceiver operative to transmit and receive the first
type RF signals. The second type RF transceiver means of
said communication device is operative to transmit and
30 receive second type RF signals for communicating with a
remote transceiver. The remote transceiver is operative
to transmit and receive said second type RF signals and is
coupled to a remote data terminal. The remote data

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terminal may be a central data processing apparatus, such
as a host computer. The remote data terminal may, in the
alternative, interact with the remote transceiver, and a
second, long range remote transceiver to relay data over
5   yet greater distances to yet a further long range
transceiver. The hierarchical data communications system
thus allows the first type data devices to be
communicatively coupled to the further long range
receiver. Advantages are realized in a large area radio
10   frequency communications net, which is operative with a
great number of relatively low cost devices at an outer
working perimeter of the system. In that the low cost of
the first type RF transceiver means in conjunction with
avoidance of installation costs and maintenance of a fixed
15   wiring system tends to provide a more cost effective and
more flexible communication system, cost savings may be
realized at the outer working perimeter of the
communication system. The second type RF transceiver
means having a longer transmission range than the first
20   type RF transceiver means may comply with more rigid
transmission specifications.

In accordance with a particular aspect of the
invention, a portable dual RF transceiver communication
device having transceivers of the first and second types
25   is communicatively coupled by a radio frequency
transmission link of a first type to at least one data
terminal device including a transceiver of the first type,
and is communicatively coupled by a radio frequency
transmission link of a second type to a remote, fixed base
30   station.

A method according to the invention includes
communicating at a first type radio frequency between at
least one mobile data communication device and at least

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one modular data terminal device. Such data messages at a
first type radio frequency between are relayed by such at
least one data terminal device to a base station at a
second type radio frequency. The data communication
5   device may selectively extract predetermined data from
received messages and relay only selected data between
said base station and said at least one modular data
terminal device. The data communication device may
further communicate with a plurality of modular terminal
10 data devices and redirect selected data as data messages
among such plurality of modular terminal data devices.

BRIEF DESCRIPTION OF THE DRAWINGS

The Detailed Description of the Invention will
be best understood when read in reference to the
15 accompanying drawings wherein:
FIG. 1 is a schematic representation of a
multi-order radio frequency communication system
illustrating in block format major elements of the
invention;
20 FIG. 2 is a simplified schematic diagram of an
alternate embodiment of the invention;
FIG. 3 is a block diagram of major components of
a communication device including features of the present
invention;
25 FIGs. 4 and 5 are simplified representations of
uses of the communication device shown in FIG. 3 and of
data terminal devices embodying features of the present
invention;
FIG. 6 is a flow diagram showing operational
30 steps of a communication device in accordance with the
present invention;
FIG. 7 is a simplified representation of a data

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terminal device including features of the present
invention;

FIG. 8 shows a schematic diagram of a further
embodiment of the present invention;

5   FIG. 9 is a simplified representation of details
of a communication device in accordance with the present
invention enabling a data terminal device to be
temporarily coupled thereto;

FIG. 10 is a schematic representation of another
10   embodiment of the present invention;

FIG. 11 is a simplified representation of a data
entry device for illustrating certain features of the
invention; and

FIG. 12 is a pictorial representation of a
15   receptacle for the data entry device shown in FIG. 11.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 1, there is shown a
multi-order or multi-level mobile data communication
system or data system designated generally by the numeral
20   10. The term "mobile" applies to certain user devices of
the data system 10, in that they are either portable in
the sense of being self-contained by being internally
powered, or by being of a convenient size and adapted to
being carried about by an operator without effort, or
25   having both of the above characteristics. For most
applications of the data system 10, the term "mobile" does
not apply to a data station ("DATA STATION"), also
identified by numeral 11. The data station 11 is
representative of a central data processing station,
30   typically referred to as a "host", namely a host computer
11. The host computer 11, though certainly capable of
being mobile as referred to herein, is typically

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stationary and would normally be located in a central
location. The host computer 11 may be a mainframe
computer or one of a new generation of high capacity desk
top computers. In any case, the host computer 11 is

5   intended and expected to be of sufficient processing
capacity to serve the needs of the data system 10. While
the data system 10 as further described herein may
communicate with a mainframe such as the host computer 11,
the host computer 11 need not be part of the data system

10 10, as herein further described, for the data system to
function in accordance with the invention.

The host computer 11 typically may be coupled
via a typical communication link, such as a communication
cable or optical fiber data conductor 12 to a

15 communication interface 15. The term "communication" as
used herein applies to sending and receiving digital data
messages. Communication may take place through such data
conductor 12 or via radio frequency transmissions and
receptions. When a data message is described as being

20 transmitted from one device to another, an established
link is presumed. However, though a message is generally
received by all terminals operating on the same frequency,
selective addressing precludes processing of a message not
addressed to a particular terminal. Therefore, the term

25 "communication" also includes "selective communication".

The above communications interface 15 may be
located in proximity of the host computer 11 or may be
somewhat remotely located at a convenient site for
expedient transmission and reception of data messages.

30 The communications interface 15 preferably consists of a
communications multiplexer module 16 and a transceiver 17.
The transceiver 17 is, in the described embodiment of the
invention, a frequency modulation ("FM") transceiver,

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capable of operating on a frequency band allocated by the
Federal Communications Commission to industrial FM
transmissions. (Alternatively, a spread spectrum
transceiver may be used.) The transceiver 17 is referred

5   herein as having a high power transmitter and
corresponding receiver module. Typical "ranges" over
which such a transceiver can effectively transmit may be
to five thousand feet or even longer. Transmission
standards established by the Federal Communication

10 Commission are, consequently, strict. Hence, tolerances
on components used are narrowly defined. Manufacturing
costs and quality assurance procedures are moderately high
to meet or exceed the required transmission standard. The
term "high power" is used as a relative term to identify

15 and distinguish one type of data transmission operation
with respect to another type of transceiver module of a
data communication device 18.

            The communication device 18 also includes a
transceiver 17 having the high power transmitter module.

20 Consequently, the transceiver 17 of the communications
interface 15 is capable of communicating along a
communication link 19 between antennae 20 and 21 of the
communications interface 15 and the communication device
18, respectively. The communication link 19 represents

25 the high power transmission link. The respective
transmission module, the transceiver 17, require a
relatively substantial amount of power considering battery
operation. The communication device 18, as herein
described, is generally "portable" or "mobile". A self-

30 contained power source is, hence, of sufficient weight to
warrant the communication device 18 to have provisions for
being carried on a belt 22, when the device is to be
carried about by a person as, for example, in FIG. 4. The

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communication device 18 may also be vehicle-mounted, such
as in a route delivery truck or on a forklift truck for
use in warehouse operations. When mounted in a truck or
on a forklift the communication device 18 may conveniently
5   be powered by resident vehicle power.

It should be noted that the antennae 20 and 21
are represented schematically by typical triangular
antennae symbols in distinction to a symbolic
representation of another antenna 24 of the communication
10 device 18, shown as a stick with a rounded end. The
antenna 24 represents the antenna of what is referred to
herein as a "low power" transceiver 25, a transceiver unit
functional with first type radio frequency transmissions,
preferably low power type transmissions in comparison to
15 that of the transceiver 17. The transceiver unit 17 could
then be characterized as having second type radio
frequency transmissions or comparatively high power
transmissions. As will become apparent from the following
description of the respective functions and modes of
20 operation of the transceivers 17 and 25, their respective
communications should desirably not overlap. The
transceivers 17 would consequently operate using a
communications channel different from that of the
transceivers 25. Different channels imply different
25 frequencies or modulation methods. Nevertheless, a single
antenna may be used for both the high power and low power
transceivers 17 and 25, such that the antennae 21 and 24
are shown as being different primarily to distinguish the
high power and low power transceivers 17 and 25 from each
30 other.

In contrast to the high power transceiver 17,
the transmission range of the low power transceiver 25 is
short. The typical low power transmission range may be

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between ten and fifty feet, and the maximum range of
transmission may be limited for example to no more than
few hundred feet. For such lower power transmitting
devices, communication standards are more relaxed.

5   Consequently, the transceiver 25 can be manufactured for
much lower cost. The economics of the multi-level
communications system are based on cost advantages which
substitute the transceiver 25 for typical wiring. A
greater number of devices operating at the first or lowest

10 level of the hierarchical communication system can amount
to significant cost avoidance with a corresponding
increase in flexibility within the system 10.

       The communication device 18 is described herein
as a mobile or portable device. FIG. 1 shows

15 schematically a connectible power source 26, including for
example a rechargeable type NiCad battery with desirably
supporting circuitry to permit alternate power to be
supplied and to control a recharging operation. The power
source or battery 26 may be housed separately or be

20 included in a common housing 27 with the communication
device 18. The battery may be coupled to the
communication device 18 in a typical manner to power both
the high and low power transceivers 17 and 25,
respectively, as well as a communication module ("COM"),

25 also identified by the numeral 28. The communication
module 28 of the communication device 18 preferably
includes such data modulation and demodulation circuits as
are typically used in converting digital data signals into
signals for transmission by either transceivers 17 or 25.

30 The communication module 28 may further include
identification and address circuits for implementing a
protocol for a Local Area Network ("LAN").

       In reference to FIG. 3, there is shown a block

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diagram of major functional blocks which may be separately
identified in describing the operation of the
communication device 18. In addition to the high and low
power transceivers 17 and 25, and the communication module
5   28, the communication device 18 is microprocessor
controlled, and includes a processor circuit or
microprocessor 29 ("MICRO PROCESSOR") of a type having the
capability of addressing two separate radio frequency
transceivers, such as the transceivers 17 and 25.

10   Typical state of the art microprocessors have
the capability of processing data messages. The term
"processing" as used herein includes a sequence of
operations, typically controlled by an instructional
program. The instructional program may be referred to as
15 a "protocol". Data messages may contain one or more
address codes, also instructional codes, and data codes.
The microprocessor 29 has the capability of reading and
interpreting a received data message. The microprocessor
29 typically responds by identifying an address or
20 instructional code, storing the address or instructional
code and the received data codes, storing the memory
addresses of stored information, and by acting on
instructions to assemble data messages and send such
assembled data messages to an assigned device. More
25 specific operations relate to controlling the low power
communications in general, and to be available, on
command, to receive from and transmit to the high power
communication level. To avoid interference between local,
low power communication and long range, high power
30 communication, different channels may typically be
assigned to low power and high power transmissions.
However, to avoid interfering data communication
transmissions on the local, low power level, the

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communication device 18 may disassemble received data
messages and readdress portions thereof with another
address code for retransmission on the local level to the
designated data terminal device. Other portions of a
5   received data message may be assembled into another data
message to be transmitted to another data terminal device
on the local, low power level. Collectively the
operations are referred to as "processing". In the
specific environment of the communication device 18 the
10 processing functions may not differ much in number from
those of the host computer 11. However, they are
dedicated to the specific purpose of relaying information
between the low power and the high power data
communication levels.
15   In the architecture of the communication device
18, modifications are possible within the scope of the
invention. It may, for example, be desirable to use two
separate, concurrently operating microprocessors 29 in
substantially parallel operation, each to control the
20 operation of a respective one of the transceivers 17 and
25. The operation of the microprocessor 29 typically
includes a random access memory module 30 ("RAM") for
temporarily storing address codes, temporary control codes
and data extracted from received data messages. The
25 storage capacity of the memory module 30 may vary,
depending on the demands made on stored information and
the type of operation desired. If information received
via the low power transceiver 25 is to be uploaded to the
host computer 11 only periodically as a batch
30 transmission, then a greater storage capacity for the
memory module 30 is desirable. If, however, data are
relayed through the communication device 18 on a real time
basis, then a comparatively smaller memory capacity in the

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memory module 30 may suffice. It may also be desirable to
use the data processing power and capacity afforded by the
microprocessor 29 and memory 30 to provide data processing
within the communication device 18. Data are routed
5 between the described functional circuit modules by a
typical data bus 31. Also coupled to the data bus 31, the
communication device 18 would further comprise a read only
memory 32 ("ROM"). The memory 32 typically contains
predetermined or fixed information, such as the operating
10 protocol for receiving and transmitting data messages,
extracting address codes from data messages, extracting
data from data messages, routines for temporarily storing
address codes and data, and various other routines as will
become apparent from a description of the operation of the
15 data system 10. In a particular embodiment of the
invention as described in reference to FIG. 1, the read-
only memory 32 would include operating instructions to the
microprocessor 29 as protocol for the operation of a LAN
in accordance with the present invention. By
20 incorporating the referred to LAN control or master
protocol in the memory 32 of the communication device 18,
the communication device 18 becomes effectively a LAN
controller for a number of data terminals 33 through 39 as
shown in FIG. 1. Typically, a LAN type operation permits
25 data terminals within the LAN to communicate on an equal
level among each other. Accordingly, all transceivers 25
being part of the same LAN would operate on the same radio
frequency or channel. Thus, typically a transmission by
any of the transceivers 25 may be received by all other
30 transceivers within the LAN. The typical LAN type
operation among the data terminals, such as the data
terminals 33 through 39 is altered in accordance with a
preferred embodiment of the current invention.

Accordingly, the communication device 18 controls
communication among the data terminals 33 through 39 by
functioning as a communication relay device to
selectively, by specifically addressing, re-transmit data
5 messages received from one of the data terminals 33
through 39 to another one thereof. The data message must
be re-addressed by the LAN controlling protocol, lest the
data message be received by the receiving data terminal
device upon its first transmission from the originating
10 data terminal device to the communication device 18.
Input and output signals are translated from or to such
initial data signals to or from data messages of
communication between the respective communication device
18 and a selected and specifically addressed one of the
15 data terminal devices 33 through 39.

         The data terminals are particularly identified
as specific examples of various data terminal devices
which may be coupled to function as a system as herein
further described. In general, a data terminal is a data
20 transducer. For example, the identified data terminal
devices may be data input devices, data output devices,
both or even a combination of a plurality of such devices.
Whether they are data input or output devices, the data
terminal devices "transduce" data from one form to
25 another. A data output device would receive data from
within the system and display the data as an output of a
different form. In particular, a card reader 33 ("CARD
READER"), a scanner 34 ("SCANNER"), a keyboard 35
("KEYBOARD") and scales 36 ("SCALES") would be typical
30 data input devices, in that data are obtained by such
devices from sources external to the system 10, to be
"transduced" or translated by the devices into digital
binary data signals which can be communicated by

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electronic transmission within the system. The scanner 34
may read various types of indicia, such as bar codes,
characters or text, or capture signatures. Though the
above input devices may primarily direct data into the
5   system, address codes may nevertheless be received by the
input device. Consequently, whether the primary data
stream is in one direction only or in two directions, the
process of transferring data either to or from a device is
referred to herein as data communication.
10   The card reader 33 could in a most common
example be a magnetic stripe reader for reading
magnetically encoded identification data of a bank charge
card or credit card and for translating such data into
digital signals. The scanner 34 may be a typical laser
15 bar code reader or other label reader for identifying
marked codes on merchandise items (not shown), and for
also translating such identified codes into digital binary
coded data signals. Various models of such laser scanners
34 are known and are commercially available. The keyboard
20 35 may be an alphanumeric keyboard of standard size for a
computer or typewriter, or it may be an alphanumeric
keyboard of compressed size, as used with respect to
portable, hand held data terminals. The keyboard 35 may,
of course, be simply a numeric keyboard including possibly
25 certain function keys, such as addition or other
instructional codes. The scales 36 are contemplated to be
digital electronic scales, an output of which is
communicable by digital signal transmission.
            In distinction over the described data input
30 devices, the display 37 and the printer 38 are data output
devices. The display 37 may be an LCD display, which may
comprise an output screen of several lines for displaying
alphanumeric data, or it may be one of several known

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luminescent data display screens including a typical
cathode ray tube. For reasons of portability, an LCD
display screen is preferred because of typically lower
power requirements with respect to other display screens
5   in the operation of such a device. The printer 38 may be
a thermal printer. The described data output devices
receive data as binary data messages and translate such
messages into typically alphanumeric display character
messages, hence into human-readable messages. The printer
10 38 may also be a bar code printer, translating the
messages into machine readable format.

In reference to FIG. 1, the described data input
and output devices and the alternate data terminal device
39 ("ALTERNATE") are uniquely characterized in that each
15 includes one of the low power transceivers 25. Each of
the data terminal devices 33 through 39 also includes the
communication circuit 28 or similar circuitry for
modulating and demodulating data messages. Each of the
data terminal devices 33 through 39 desirably also
20 includes a microprocessor and stored protocol as well as
random access memory, as shown by the microprocessor 29,
the read-only memory 32 and the memory 30 in FIG. 3,
except that only the single transceiver 25 is present and
programmed to be addressed. Each of the data terminal
25 devices 33 through 39 preferably also includes a self-
contained power source 40, as indicated by the stacked
block representation in FIG. 1.

Because of a lower power requirement of the
transceiver 25 with respect to the transceiver 17, the
30 power requirement for the transceiver may be small, in
comparison to the power requirement of the corresponding
data terminal device. Since the power source 40 is
adapted to serve the needs of both the data terminal

device and the low power transceiver 25, the power source
designated 40 may vary in size and storage capacity,
depending on the type of device to be served, and will be
generally smaller than that of device 18. In a particular

5 embodiment illustrated in FIG. 9, the data terminal device
39 comprises a combination of input and output devices,
and in particular the functional keyboard 35 and the
functional display 37. Because of the typically low power
requirement of both keyboard and display, the major power

10 consuming device is the transceiver 25. A criterion of
the hand held data terminal device 39 as configured is an
optimally minimal weight. FIG. 9 consequently shows a
configuration in which the communication device 18 is
belt-carried and comprises a high capacity self-contained

15 power source 26. The communication device 18 is
configured to include a guide track 41 and contact
elements 42. The data terminal device 39 features a
complementary guide track 43 and contact elements 44
complementary to the contact elements 42. The

20 communication device 18 together with the high capacity
battery or power source 26 has comparatively much greater
weight than the data terminal device 39, as configured as
hand held data terminal. Between uses, the operator may
temporarily seat the data terminal 39 on the guide track

25 41 of the communication device 18 which forms a holder for
the data terminal. While the data terminal 39 is seated
as described, the power source 40, such as a NiCad battery
of smaller capacity than the power source 26, may be
recharged by the power source 26. The self-contained

30 power source of each such data terminal device 33 through
39 may in some user configurations advantageously be
replaced by alternate external power supplied from
available line sources. This may be particularly

desirable when the data terminal devices 33 through 39
become functional units of a service vehicle, such as a
typical route delivery vehicle or a typical warehouse
vehicle, such as a forklift truck (not shown). While it
5   may be desired to provide such connectible external power
and the respective power wiring, such wiring is
nevertheless more simple than the provision of a vehicle
installed LAN. Power supplied to each of the data
terminal devices is preferably of the same voltage, such
10 that the power connectors are typical and may all be of
the same type. This is different with respect to data
communication wiring which may need to differ depending on
what type of data terminal is to be installed.

       With respect to radio frequency data
15 communication, the protocol stored in each respective one
of the memories 32 is capable of identifying the
respective data terminal device as to its characteristic
function when placed "on-line." Thus, each of the data
terminal devices 33 through 39 have the capability of
20 becoming integrated into the LAN upon becoming functional.
The distinction over a LAN is that the typical hard wiring
and terminal adapters are eliminated.

       An immediate advantage is that products
fundamentally dissimilar in a mechanical sense can be
25 added. As another data terminal device 39 with a
previously not anticipated mechanical configuration
becomes a desirable addition to the previous system, such
device may be added via the low power transceiver 25. The
transceivers 25 become "connectors" for coupling any such
30 additional devices into the system. The LAN, as described
herein within the scope of this invention could therefore
be referred to as a "virtual" LAN. Though an immediate
distinction, the elimination of the wiring, however, may

not be the most significant advantage of the wireless LAN.
Instead, a major advantage is seen in an increased
flexibility to adapt the presence of functional units or
data terminal devices to serve a particular need with
5   essentially no other effort or cost than that of the added
device. Product innovations can be made in which the new
products need not be bound by physical compatibility
constraints. The referred to flexibility extends to both
additions and deletions of functional units such as the
10 data terminal devices 33 through 39. Any one of the
devices may be deleted from or moved within the data
system 10 and assigned to another user location. The
described functional exchange further includes the ability
to exchange any defective data terminal device 33 through
15 39 for a functional equivalent. If it is desirable for
several of the described LAN systems to coexist in
proximity different operating channels may be chosen. For
each LAN it may be desirable to provide each of the data
terminal devices 33 through 39 with a removable cartridge
20 45 which may contain the memory 32 with data identifying
the data terminal device with a particular LAN, as shown
in FIG. 7 with respect to the data terminal device 39
("ALTERNATE"). The cartridge 45 may also contain a
dedicated communication circuit or program to assign or
25 configure a predetermined communication channel to
establish the desired communication link between the
respective device 33 through 39 and the corresponding
communication device 18. Electrical contact elements 46
which may be disposed on the cartridge will be urged into
30 contact with complementary electrical elements (not shown)
located within the respective data terminal device.
        The data terminal device 39 may be any of a
number of devices including, or other than, the data

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terminal devices 33 through 38 already described in
detail.   As an example of a data terminal device 39 other
than those already described, reference is made to a
mobile vending system. In a mobile vending system, such
5   as a delivery vehicle for delivering pizza or ice cream or
any other route delivery operation, the driver may be
likely to handle significant amounts of cash.   In such an
operation a truck-mounted cash drawer may be desirable.
The alternate data terminal device 39 may consequently
10   represent a cash drawer.   The alternate data terminal may
also be a transducer of data relating to the operation of
the vehicle itself, for example, providing data records on
the number of miles driven or on fuel consumption.   As
another example, the alternate data terminal device 39 may
15   be a portable data entry terminal which may be used by
door-to-door vending or polling operations.   Data are
entered by such a portable data entry terminal and are
immediately transmitted to the communication device 18.
The communication device 18 itself may be belt-carried by
20   an operator, as shown in FIG. 4, or it may otherwise be
mounted in a vehicle parked in proximity.   In the latter
example, the data terminal device 39 may include the
already described circuit functions of keyboard and a
display device.   The device 39 would nevertheless be
25   considered within the LAN as a single data terminal
device.   As a data terminal featuring a keyboard and
display, the device does include both data input and
output functions and would be recognized as such by the
respective communication device 18.
30   A particular advantage of the data terminal
device 39 over state of the art terminals is that data
storage and other functions may be minimized by removal
from the hand-held device to a self-contained data

terminal device of the LAN. Extensive portable computing
power or customer information storage devices may, for
example, be carried in another data terminal device 39 on
the belt of the operator. The data terminal device 39 may
5   use the data storage capacity and processing power
afforded by the communication device 18, or communicate
via the communication device 18 with the host computer 11.
Thus, FIG. 4 showing the communication device 18 carried
on the belt of the operator could also show a data
10 terminal device 39 carried by the operator in a similar
manner. FIG. 5 shows an alternate embodiment in which a
data terminal device 39 is belt-supported and carried by
an operator. The data terminal device includes a
separate, hand held data entry module 47 which is coupled
15 to the data terminal device 39 by an electric cord 48.
The data entry module 47 depicted in FIG. 5 includes a
keyboard 49, a printer 50, a display screen 51 and a laser
scanner 52. The power source 26 for the hand held
elements of the data entry module 47 is preferably located
20 with the transceiver 25 on the belt of the operator.
Other supporting circuitry, to the extent possible, such
as memory modules, and any other elements which are not
needed in the hand held module 47 itself, are also
contained in the device 39 as carried by the operator's
25 belt. An advantage is a minimal weight without loss of
functions with respect to state of the art data terminals.
State of the art terminals which include such elements as
a keyboard and display as well as a printer and laser
scanner traditionally have had substantial hand-supported
30 weight and size.

        Referring to FIG. 2, there is shown alternate
embodiment of the data system 10 as described in substance
with respect to FIG. 1. In particular, the communication

device 18 shown in FIG. 1 has been modified in that the referred to LAN control protocol has been removed to result in the communication device designated by the numeral 55 in FIG. 2. The communication device 55, except

5   for not having the capability of functioning as a LAN controller, includes all of the functional elements of the communication device 18, as described in reference to FIG. 3. Thus, in order for the LAN to function, one of the data terminal devices, identified by the numeral 56,

10 becomes a LAN controller. The LAN controller 56 includes as a component of the data system 10 the described functional elements typical of a data terminal device, namely the transceiver 25, the communication module 28, the microprocessor 29, the memory 30 and the read-only

15 memory 32, functionally coupled as in FIG. 3, except for the high power transceiver 17 and its support functions. The use of the separate LAN controller 56 results in an advantage which frees the communication device 55 from continuous contact with other data terminals of a

20 particular LAN, such as identified generally by "D. TERM. 1" through "D. TERM 5", also identified by numerals 57 through 61, respectively in FIG. 2. The LAN controller 56 in accordance with the described hierarchical operation would exercise the function of polling the addresses of

25 possible data terminals 57 through 61. In a first alternate embodiment, the LAN controller may also poll the low power transceiver 25 of the communication device 55. The LAN controller's function of polling the LAN device is a deviation from the preferred hierarchical communication,

30 in that the communication device 55 is the link or interface to the next higher level communication. As such the communication device 55 may be preferred to control its own operation, as described in the following alternate

embodiment.

A second alternate embodiment of operation
places the communication device 55 on a second level of
the data or communication system 10. Accordingly, the LAN
5   controller polls only the data terminal devices 57 through
61 in low power radio frequency communication. The LAN
controller receives data messages in response to such
polling operation, and relays the data in accordance with
received addresses of data messages and stores those of
10 the received data that are to be further communicated
within the data system 10. The communication device 55 in
this latter embodiment also contains a protocol for
polling data terminal devices. Accordingly, the
communication device 55 selectively polls or addresses the
15 LAN controller 56. Upon receipt of a "handshake" signal
indicating a message to be transmitted to the
communication device 55, hence to be uploaded within the
hierarchy of the data communication system 10, the LAN
controller transmits to the communication device 55.
20 Thus, in this latter embodiment, the LAN controller 56
functions as a communication device as described herein,
except that both the active polling function and the
passive function of being polled or addressed with a
message transpires over the same, low power transceiver
25 25.

In accordance with a "soft" coupling of the data
terminal devices of the data system 10 in general, a
device which is not functional within the LAN is also not
logged on, so that the absence of any one of the data
30 terminal devices from the LAN does not generally affect
the operation of the remaining data terminal devices
within the LAN. Consequently, it is possible to remove
the communication device 55 temporarily from the LAN

identified in FIG. 2 by the numeral 62, without affecting
the operation of the LAN 62. In the latter alternate
embodiment the communication device 55 is further capable
of selectively addressing and polling a plurality of LAN

5   controllers 56. This latter operation permits several
identical combinations of data terminals to be controlled
selectively by the communication device 55 via separate
LAN controllers 56.

A temporary removal or deactivation of the

10 communication device 55 also temporarily interrupts
communication with the host computer 11 via the
communications interface 15. Such interruption may be a
desired condition for certain system configurations in
which the number of the communication devices 55 which may

15 be addressed is limited. A single communication device 55
may then selectively be switched between LANs to upload
data to the host computer 11 from more than one LAN
without interruption of the continuous operation of the
LANs.

20 A particular mode of operation of a first or low
level communication may be explained in reference to FIG.
1. The mode is one in which the communication device 18
controls the LAN and relays data messages to the data
terminal devices 33 though 39. In operation, the

25 communication device 18 communicates with the data
terminals 33 through 39 by, for example, sequentially
polling each available address that may be populated by
one of the data terminals to establish whether data are
ready to be submitted by a respective one of the terminals

30 polled. If the respective data terminal polled has a data
message available, the data are transmitted from the
respective data terminal and received by the communication
device 18. Similarly, when data are to be transmitted

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from the communication device 18 to one of the data
terminals 33 through 39, a presence "handshake" signal may
first be received from a specifically addressed one of the
data terminals. The data message is then transmitted by
5   the communication device 18. While the transmitted data
message may be received by the respective transceivers 25
of any and all of the data terminals present, the message
is typically addressed in a manner to be uniquely
identified only by one of the data terminals. The
10   protocol may permit also simultaneous transmissions to
more than one of the data terminals. For example, it may
be desired to send a data message simultaneously to the
printer 38 and to the display 37. The protocol may be
configured to recognize a certain data message from the
15   keyboard 35 to address a re-transmitted data message to be
received and applied simultaneously by the printer 38 and
the display 37 as a simultaneous data message
communication. It may also be desired to "broadcast" to
all of the data terminal devices within the LAN. An
20   example of such a broadcast message than may be desirable
under certain circumstances would be a general "reset"
command communicated simultaneously to all devices within
the LAN.

          The keyboard 35 transmits through its
25   transceiver 25 the data message to the communication
device 18. At the communication device 18, the protocol
identifies the received data message as having originated
at the keyboard 35. Thus, the data message may be stored
in the memory module 30 and may also be re-transmitted to
30   the display 37. In effect, the keyboard has communicated
data to the display 37. Additionally, the data have also
been stored in the communication device 18 for further
processing or transmission. The described operation

pertaining to communication between the data communication
device 18 and the data terminals 33 through 39 is referred
to as first level communication. The described first
level communication is the low power, short range
5 communication.

The flow diagram of FIG. 6 illustrates as an
example a polling type mode of communicating with both
high and low power data message transmissions and
receptions. For an understanding of the following
10 description of major communication steps, reference may be
made FIG. 1. The described mode of operation of the
communication device 18 does, however, also apply to the
communication device 55. In accordance with the
hierarchical data communication set forth herein, the
15 polling referred to herein transpires preferably in a
"downward" directed mode. As an example, in a multi level
communication system, the highest level may be a "third"
level. Thus, the third level communication device may
poll on a third level a plurality of second level
20 communication devices. In turn, the second level
communication devices, which may be the communications
interface 15, would poll on a respectively second level a
plurality of first level communication devices, such as
the communication device 18. The communication device 18,
25 in turn, polls on a first or lowest level of communication
the data terminals 33 through. 39. It should be
understood that a protocol according to which a plurality
of data terminals are polled is but one of a number of
acceptable protocols according to which data may be
30 selectively communicated among such data terminals. Other
protocols are also well known and have been used in
addressing selected ones of a plurality of data terminals.
Among protocol types which are known in the art and which

may be employed for LAN communication are, for example,
contention type protocols. For example, a "carrier sense
multiple access" ("CSMA") protocol is a contention
protocol which may be used in a LAN. It may be desirable
5   to substitute a contention type protocol for data terminal
device polling in certain implementations of the
invention.

The flow diagram in FIG. 6 illustrates for
example a pattern of communication on a first or lowest
10 level, such as between the communication device 18 and the
data terminal devices 33 through 39, and communication to
its next higher level. Beginning at the top of the flow
chart, one of the low level devices is polled. When data
are ready to be transmitted by one of the data terminal
15 devices, for example the card reader 33, "data ready" is
answered in the affirmative and the communication device
18 receives data from the reader in form of a first level
radio frequency transmission. The received data message
typically including at least one address code and data
20 codes is stored in the memory module 30 (see FIG. 3).

A following step is identified as a protocol
check. The communication device 18 needs to determine
what to do with the received data message or information.
The step "interpret address and protocol" refers to
25 obtaining routing information from an address code portion
in a check against program instructions referred to as
"protocol". For example, if the received data message is
an input from the card rea r 33, the information may need
to be transmitted to the ho t computer 11 for
30 verification. The following test steps show results
dictated by the programmed protocol in light of the
"address" information of the data message.

In that the "address" code may denote not only

origin but also destination information, the "address" may
be considered indicative of routing information. Routing
instructions are implemented in reference to the
programmed protocol. With respect to the example, the
5   "transmit" and "upload" queries are answered in the
affirmative, the data message is read from memory and
transmitted on the next higher level, as indicated by the
steps "read address & data" and "transmit H-level data".
        The flow chart depicted in FIG. 6 should be
10   understood to be a simplification for illustrative
purposes of a representative operational sequence of the
communication device 18. A typical simplification becomes
apparent with respect to another example. A data message
is received as described from the keyboard 35. The
15   protocol may, for example, provide for the received data
to be transmitted on the first or lowest level to the
display 37. Also, the "data" may have represented a query
from the keyboard to the host computer requesting a
current price on an item number transmitted in the data
20   portion of the data message. A query code in the address
determines that the data need to be communicated to the
host computer 11. Thus, the "upload?" question is then
answered in both the negative and the affirmative, such
that the data message may be transmitted under "transmit
25   L-level data" to the display and also via the "transmit
H-level data" via the communications interface 15 to the
host computer.
        An alternative procedure may assign first level
or first order communication priorities. Accordingly, in
30   the last example, the receipt by the communication device
18 from the keyboard 35 is addressed and transmitted
without delay to the display 37 to allow the request to be
visually verified before an address instruction is

executed to transmit as an "upload" via the communications
interface 15 to the host computer 11. In general, a
protocol giving first level communication priority is
preferred. The data terminal devices 33 through 39 are

5 typically expected to interact as a local system through
the "virtual LAN". Thus, delays in transmitting data from
the keyboard 35 to the display 37 within the same level
may be undesirable. A delay of reasonable length in
receiving a reply from the host computer 11 may typically

10 be expected. Typically the communications interface 15,
as shown in FIG. 8, would serve a substantial number of
similar communication devices 18, generating opportunities
for short transmission delays to some of the communication
devices 18.

15   In reference to the polling operation shown in
the flow diagram of FIG. 6, after having polled one of the
data terminal devices with the result of no data ready,
the protocol may cause the communication device to check
whether the communications interface 15 is ready to

20 download a data message to the respective communication
device 18. If the query is negative, the polling of the
data terminal devices continues. If the check of second
level data waiting ("H-LEV. INTERRUPT?") is answered in
the affirmative, the communication device 18 receives the

25 data message, stores its address and data portions and
continues to process the received data message in a manner
described with respect to the receipt of a low level or
first level data message.

          FIG. 8 illustrates further the hierarchy of the

30 high power, low power communication and the resulting
multiple of operations possible within the data system 10.
In the schematic representation of the data system 10 in
FIG. 8, the high power transceiver 17 of the

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communications interface 15 is operated in a multiplex
mode in which the communications interface 15 is capable
of addressing a predetermined number, for example sixteen,
of the communication devices 18. The devices 18 are
5   generally located remote from each other. Each of the
devices 18 is typically an active receiving unit within a
separate LAN. Thus, each of the LANs would contain one or
more low power transceiver 25, each low power transceiver
25 representing a terminal of a communication link to a
10 respective data terminal device ("ALT"), which may be any
of the terminal devices described or referred to herein.
     The communications interface 15 controls data
communication between any of a plurality of LANs and the
respective host computer 11. A communication link 65
15 between the communications interface 15 and the host
computer may be a data conductor such as the data
conductor 12 referred to with respect to FIG. 1, or the
link 65 may be one of a number of links of yet a third
level of multiplexing to the host computer 11. In either
20 case, the communications interface 15 relays data messages
based on instructions from the host computer 11 to the
communication devices 18 and their respective LANs.
     FIG. 10 illustrates a further alternate
embodiment of the data system 10 described with respect to
25 FIGS. 1, 2 and 8. In particular, FIG. 10 illustrates
schematically the substitution of a data terminal and
communication device 70 for the communication devices 18
or 55 illustrated in FIGS. 1 and 8 or FIG. 2,
respectively. The data terminal and communication device
30 70 combines with the features and functions of the
previously described communication device 18 a display
device 37, such an LCD display device, and a keyboard 35
which may be an alpha-numeric keyboard and may include in

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addition keys which double as function keys in accordance
with current practice for data terminals.

The diagrammatic block representation of a
"MICRO PROCESSOR & MEMORY" circuit 71 would typically
5   include the microprocessor 29, the RAM memory 30, the ROM
memory 31 and interconnecting portions of the data bus 31
as hereinbefore described. The microprocessor 29 may be
modified as already described to include at least one
additional processor circuit, while the memory 30 may be
10   expanded to support within the device 70 data storage and
processing functions of a computer. The "PWR" battery
pack 26 is desirably coupled to power all functions of the
device 70 via data and power bus 72.

The device 70 may be portable in the sense of
15   being carried about by a person while such person may
actually be operating the device 70. Such operation may
be active communication with one or more of the data
terminal devices 33 through 39 via the low power
transceiver 25. Alternatively, the person may be
20   communicating via the high power transceivers 17 with, for
example, the host computer 11, or in the absence of
communication with the latter, by working the keyboard to
process data locally. The device may also be considered
portable in the sense of being mounted or installed in a
25   vehicle (not shown), such as a delivery route truck.
Also, in warehouse type operations, the device 70 may be
installed on a forklift vehicle to communicate with one or
more data terminal devices 33 through 39.

The device 70, consequently, enhances the
30   operation of the communication device 18. As the
communication device 18, the device 70 supports the
described LAN type operations as first, low power level
communications, or by relaying data messages by converting

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low power radio frequency communications to high power
radio frequency communications or vice versa.   In
addition; the device 70 functions as a local data
processing station.   The data processing enhancement may
5 be of particular importance when mobile operation from a
vehicle is desired and the device 70 is temporarily out of
communication range even on the high power communication
channel of the transceiver 17.

   The device 70 has the further advantage of
10 allowing resident data to be manually changed in
accordance with changed conditions which may be
encountered on a real time basis.   For example in
inventory control operations, the device 70 may contain
all initial data relating to merchandise items in a
15 warehouse.   As a LAN controller, the data terminal may
communicate on a low level with a plurality of the data
terminal devices 39 relaying data to the device 70, while
the person operating the device 70 may supervise an
inventory taking operation.   Simultaneously with being
20 able to send instructions to operators of the data
terminal devices 39, the operator of the device 70 may
access the data base within the device 70, compare
received data and make decisions regarding variations or
discrepancies deduced from the received data.   Similarly,
25 on a delivery route, the driver of a delivery vehicle may
be able to change an order and provide the recipient of
such order with an updated invoice.   The updated
information would be stored in the memory of the circuit
71 for subsequent transfer to the host computer 11 or
30 other data storage or processing means as may be desired.
Various other applications similar to those examples
already described may be realized when with the
enhancements of the data terminal and communication device

70.

A further enhancement of the data system 10 which particularly relates to the usefulness of the low power data terminal device 39 is found in an alternate
5   embodiment of the device 39. On a selective basis, the device 39 may be provided with a further communication device 74, in addition or as part of the transceiver 25, such as is indicated for example in FIG. 10. The device permits a data entry and scanner device 75 which may
10   functionally be part of the data terminal device 39 to become independently mobile with respect thereto. Referring to FIG. 11, there is shown a simplified representation of a data entry and scanner device 75. The data entry and scanner device 75 includes some features
15   similar to those of the data entry module 47. However, in distinction over the data entry module 47 shown in FIG. 5, the data entry and scanner device 75 includes a data input and communication circuit module 76 which is communicatively coupled to the communication device of
20   a selected one of the data terminal device 39 to support wireless communication therewith. Various short range wireless communication means are known and commercially available which may be utilized to communicate data over a very short range, such as up to ten feet. Data
25   communication may be by low power radio frequency over a special channel to the data terminal device 39 which is specially encoded for reception of data from the circuit module 76. Other modes for communicating data to the data terminal device 39 may, for example, include an ultrasonic
30   signal carrier wave. It is understood that the designated data terminal would be equipped with a compatible carrier wave transducer or receiver 74 to receive the data communication from the data entry and scanner device 75.

Other sources for short range communication may become available.

The data entry and scanner device 75 further includes a scanner head 77. The scanner head 77 shown in
5 FIG. 11 is deemed representative of any of a number of known types of scanners, such as wand types, laser types or flash types which may be used in accordance herewith. Preferably, the device 75 may include a keyboard 78, and a display 79. The keyboard 78 may be an alphanumeric
10 keyboard and may be identical to the previously referred to keyboard 35. The display 79 desirably is an LCD display because of the low power requirements for that type of display. The display 79 typically might be functional to display numerals or characters in human-
15 readable format of codes read by the scanner head. An operator may then verify the data prior to transmitting them to the respective data terminal device 39.

In case of an error in the data read by the scanner head 77, or in case of an inability of the scanner
20 head 77 to recognize the codes representing the data to be read, an operator of the device 75 may correct, override or enter data into the device and verify their correctness from the display 79. Because the device 75 is a self contained unit, the keyboard 78, display 79 and the data
25 entry and communication module 76 are operated by an on-board power source, such as a battery 40, which preferably may be rechargeable. The device is movable and usable within its functional communication range independently of the respective device 39. The use may be restricted to
30 arm movement of an operator when the operator carries the device 39 on a belt, similar to the device 39 shown in FIG. 5, or the independent range of movement with respect to the corresponding device 39 may extend to a reasonable

range of several feet, such as when the scanner is used
away from a forklift truck and the device 39 is mounted on
such truck.

Between uses the device 75 may be returned to a
5   receptacle or holster 81 shown in FIG. 11 in phantom
lines. The holster 81 may be mounted in a vehicle or may
be carried on a person's belt 22. As a particular
feature, the holster 81 is preferably provided with a
battery pack of generally considerable power carrying
10   capacity, such as a rechargeable battery 26, also labeled
"PWR". Terminals of the battery 26 may be coupled
electrically through a base 83 to make contact through the
holster 81 with external contacts 85 of the device 75.
The contacts 85 are in turn coupled electrically to the
15   rechargeable battery 40 of the device 75. Thus, during
periods of non-use, the power source or battery 40 of the
device 75 may be recharged. Such a provision for
recharging the battery 40 permits the size of the battery
40, its weight and the size and total weight of the device
20   75 to remain comparatively small while extending the time
of use of the device 75.

FIG. 12 shows somewhat simplified an pictorial
illustration of a receptacle or holster 81 for the data
entry and scanner device 75. The base 83 of the holster
25   81 is shown to contain on its underside 86 a retainer slot
87 as a representative means for releasably receiving the
battery pack 26. A quick exchange of the battery pack 26
for a fully charged battery pack 26 further extends the
usefulness of the device 75. An upright guide wall 89
30   cooperates with front guides 90 and 91 to form a seat or
socket of the holster 81 for retaining the device 75
during non-use. If the holster 81 is to be worn on a
person's belt 22, the belt may be attached to an outer

surface of the upright guide wall 89. A recess or
depression 94 which may extend the entire length of an
inner surface of the upright guide wall 89 would provide
protection to the keys of the keyboard 78 and prevent
5   accidental data entry or transmission when the device 75
is inserted into the holster. The described holster is
merely given as an example of a receptacle for the
described data entry and scanner device 75, to illustrate
a convenient means for retaining the device 75 and for
10 recharging the battery 40 during periods of non-use of the
device.

Various other changes and modifications in the
structure, arrangement and applications of the described
embodiments are possible without departing from the spirit
15 and scope of the invention.

WHAT IS CLAIMED IS:

1. A multi-level digital data communication
system including:

at least one data communication device
comprising means for processing digital data messages
having address codes and data codes and for routing said
data messages in response to instructional codes;

means for storing digital data messages coupled
to said processing means;

first means for communicating said data messages
as first type radio frequency transmission signals; and

second means for communicating said data
messages as second type radio frequency transmission
signals;

said first and second radio frequency
communication means being communicatively coupled to said
processing means for selectively transmitting and
receiving data messages to and from each of said first and
second radio frequency communication means;

at least one first type data terminal device
comprising first communication means for communicating
said data messages as said first type radio frequency
transmission signals; and

means, coupled to said first communication means
of said data terminal device, for transducing data signals
of data messages of communication between said at least
one data communication device and said at least one first
type data terminal device; and

at least one data communication interface device
comprising second means for communicating said data

messages at said second type radio frequency transmission
signals.

2. A communication system according to claim
1, wherein the at least one data communication device is a
portable device, further comprising:
a self contained electrical power source
electrically coupled respectively to said processing
means, said storage means and said first and second radio
frequency communication means.

3. A communication system according to claim
2, wherein said at least one portable data communication
device further comprises means for receiving power from an
external power source as an alternative power source to
said self contained power source.

4. A communication system according to claim
2, wherein said first radio frequency communication means
of said at least one data communication device and of said
at least one data terminal device are low power
transceivers operable on a first channel over a first
range; and
said second radio frequency communication means
of said at least one data communication interface device
and of said at least one communication device are high
power transceivers operable on a second channel over a
second range.

5. A communication system according to claim
4, wherein said at least one first type data terminal
device is a plurality of first type data terminal devices,
said plurality of first type data terminal devices being

communicatively coupled via said low power transceivers
operable on said first channel upon becoming located
within said first range.

6. A communication system according to claim
5, wherein each of said first data terminal devices
further comprises means for processing said data messages
having a first predetermined address code and data codes
and for addressing data messages with a second
predetermined address code in response to instructional
codes, and means for storing digital data messages coupled
to said processing means.

7. A communication system according to claim
6, wherein a one of the group consisting of said plurality
of first type data terminal devices communicatively
coupled to a selected one of said data communication
devices and said selected data communication device
includes means for controlling communication among said
low power transceivers operable within said first range
from said selected one of said devices.

8. A communication system according to claim
7, wherein said means for controlling communication among
said low power transceivers comprises means for storing
program instructions, said program instruction storing
means being coupled to the processing means of said one
device, said program instruction storing means including
stored instruction codes for selectively adding
predetermined address codes to at least portions of
received data messages and for directing said addressed
portions to be re-transmitted as data messages through the
low power transceiver of said one device.

9. A communication system according to claim
1, wherein:

said at least one data communication device is a
plurality of data communication devices;

said at least one first type data terminal
device is a plurality of first type data terminal devices,
at least one of said plurality of first type data terminal
devices being communicatively coupled to each of said data
communication devices via said first radio frequency
communication means operable on said first channel; and

said second means of said at least one data
communication interface device for communicating said data
messages at said second type radio frequency transmission
signals comprises means for selectively addressing data
messages to any of said plurality of data communication
devices.

10. A communication system according to claim
9, wherein the plurality of data communication devices are
portable devices, each further comprising:

a self contained electrical power source
electrically coupled respectively to said processing
means, said storage means and said first and second radio
frequency communication means.

11. A communication system according to claim
10, wherein

said first radio frequency communication means
of said plurality of data communication devices and of
said plurality of data terminal devices are low power
transceivers operable on a first channel a first range,
and

said second radio frequency communication means

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of said at least one data communication interface device
and of said plurality of communication devices are high
power transceivers operable on a second channel over a
second range.

12.   A communication system according to claim
11, wherein said at least one first type data terminal
device being communicatively coupled to each of said
plurality of data communication devices is a plurality of
the first type data terminal devices, said first type data
terminal devices being communicatively coupled to the
respective one of the data communication devices via said
low power transceivers operable on said first channel upon
becoming located within said first range of the respective
one of said data communication devices.

13.   A communication system according to claim
12, wherein each of said data terminal devices further
comprises means for processing said data messages having a
first predetermined address code and data codes and for
addressing data messages with a second predetermined
address code in response to instructional codes, and means
for storing digital data messages coupled to said
processing means.

14.   A communication system according to claim
13, wherein a one of a group consisting of said plurality
of first type data terminal devices communicatively
coupled to a selected one of said data communication
devices and said communication device includes means for
controlling communication among said low power
transceivers operable within said first range from said
one of said devices.

15. A communication system according to claim
14, wherein said means for controlling communication among
said low power transceivers comprises means for storing
program instructions, said program instruction storing
means being coupled to the processing means of said one
device, said program instruction storing means including
stored instruction codes for adding an address code to at
least portions of received data messages and for directing
said addressed portions for re-transmission as data
messages to the low power transceiver of said one device.

16. A communication system according to claim
15, further comprising a central data processing station,
and said at least one data communication interface device
further comprising means for relaying data messages
between said central data processing station and at least
one of said data communication devices.

17. A data communication system comprising the
combination of:
        at least one first type data terminal device
including first means for communicating digital data
messages having address codes and data codes at first type
radio frequency transmission signals, and
        means, coupled to said first radio frequency
communication means of said data terminal device, for
transducing data signals; and
        a data communication device including first
means for communicating data messages at said first type
radio frequency transmission signals, said first radio
frequency communication means of said data communication
device and said first radio frequency communication means
of said at least one data terminal device constituting a

radio frequency communication link between said at least
one data terminal device and said data communication
device;

means, communicatively coupled to said first
radio frequency communication means of said communication
device, for processing data messages;

means for routing data messages in response to
predetermined address and instructional codes to said
first radio frequency communication means of said
communication device for communication over said link to
said at least one data terminal device,

means, coupled to said processing means, for
storing digital data including processed digital data and
digital data messages, and

second means for communicating data messages at
second type radio frequency transmission signals, said
second radio frequency communication means being
communicatively coupled to said processing means.

18.　A communication system according to claim
17, wherein said transducing means of said at least one
first type data terminal comprises an input means for
receiving instructional impulses of a first form from
outside of the communication system and for translating
said instructional impulses into digital electrical
address and data codes.

19.　A communication system according to claim
18, wherein said receiving and translating input means
comprises a magnetic card reader and the instructional
impulses of a first form are magnetic data pulses to be
translated by an electromagnetic transducer into digital
electrical address and data codes.

20. A communication system according to claim
18, wherein said receiving and translating input means
comprises a photoelectric scanner including means for
translating scanned indicia into digital electrical
address and data codes.

21. A data communication system according to
claim 20, wherein the at least one first type data
terminal device comprises means for communicatively
coupling said scanner and said data terminal via a
wireless communication link, the scanner comprising a
self-contained power source enabling the scanner to be
independently movable with respect to said data terminal
device while operatively communicating data to said data
terminal device.

22. A data communication system according to
claim 21, further comprising a holster for retaining said
scanner, said holster comprising means for recharging said
self-contained power source of said scanner.

23. A data communication system according to
claim 21, wherein said scanner further comprises a display
device and a keyboard.

24. A data communication system according to
claim 23, further comprising a holster for retaining said
scanner, said holster comprising means for recharging said
self-contained power source of said scanner.

25. A communication system according to claim
17, wherein said transducing means of said at least one
first type data terminal comprises an output means for

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receiving digital electrical address and data codes from
within said communication system and for translating said
address and data codes into instructional or visually
discernible data identifiable from outside the
communication system.

26. A communication system according to claim
25, wherein said receiving and translating output means
comprises a bar code printer for printing bar code labels.

27. A communication system according to claim
25, wherein said receiving and translating output means
comprises a visual display of alpha-numerical data in
human readable form.

28. A communication system according to claim
17, wherein said transducing means of said at least one
first type data terminal comprises at least one input
means for receiving instructional impulses from outside of
the communication system and at least one output means for
receiving digital electrical address and data codes from
within said communication system and for translating said
address and data codes into instructional or visually
discernible data indicia.

29. A communication system according to claim
28, wherein said at least one data terminal device
comprises a hand held terminal portion, a belt carried
terminal portion and means for electrically and
communicatively coupling said hand held portion to said
belt carried terminal portion, said belt carried terminal
portion supporting said first radio frequency
communication means of said at least one data terminal

device and further comprising a self contained power
source, said self contained power source being
electrically coupled to said first communication means
and, through said electrical and communicative coupling
means, to said hand held terminal portion.

30. A communication system according to claim
17, wherein said data communication device comprises means
for couplingly receiving and engaging said at least one
data terminal device, a first type power source coupled to
and supplying electrical power to said first and second
radio frequency communication means of said data
communication device, said processing means and said
storing means, said data communication device further
having contacts disposed adjacent said receiving and
engaging means, said contacts being electrically coupled
to said first type power source, and wherein said at least
one data terminal device comprises a second type
rechargeable power source coupled and supplying power to
said first radio frequency communication means of said at
least one data terminal device and to said means for
transducing data signals, said at least one data terminal
device further comprising external electrical contacts
complementary to said contacts of said data communication
device to establish electrical connection upon engagement
of said at least one data terminal device with said data
communication device, whereby said first type power source
will be enabled to recharge said second type power source
of said at least one data terminal device.

31. A communication system according to claim
30, wherein said transducing means of said at least one
data terminal comprises at least one input means for

a self contained electrical power source
electrically coupled to said processing means, said
storage means and said first and second radio frequency
communication means.

35.   A data communication device according to
claim 34, further comprising means for controlling
communication among a plurality of data terminal devices,
said communication controlling means including means for
storing program instructions, said program instructions
storing means being coupled to the processing means of
said selected one device, said program instructions
storing means including stored instruction codes for
adding selected address codes to at least portions of
received data messages and for directing said selectively
addressed portions for re-transmission as data messages to
a selected one of the first and second radio frequency
communication means.

36.   A method of communicating data messages
interactively by radio frequency transmissions among data
terminal devices in proximity of one another and to a
remote host computer, the method comprising:
        communicating data messages at a first radio
frequency and at a low power level between any selected
one of said data terminal devices and a predetermined
controlling device;
        re-addressing selected ones of said data
messages received by said controlling device at said
controlling device, communicating said re-addressed data
messages by said controlling device selectively to a first
type transmitter for a low power level radio frequency
transmission to a selected one of said data terminal

devices and selectively to a second type transmitter for a
high power level radio frequency transmission to the
selected remote host computer.

37. A method according to claim 36, wherein
said controlling device is a communication device
comprising said first type and said second type
transceivers including said first type and second type
radio frequency transmitters, respectively, and said means
for controlling communication among said devices, and each
of said data terminal devices includes a respective first
type transceiver, said first type transceivers being
operable to transmit and receive in said first radio
frequency communications channel and said low power level,
and said second type transceiver being operable to
transmit and receive within a second channel different
from said first channel and at a high power level, and
wherein the remote host computer comprises a second type
transceiver, the method further comprising:
        communicating data messages within said second
channel and said high power level between said transceiver
of said remote host computer and said communication
device, receiving selected ones of said data messages
within said second channel and said high power level by
said communication device, and re-transmitting said
selectively received second radio frequency data messages
within said first channel and said low power level to
selected ones of said data terminals.

38. A method of communicating digital data
messages between devices throughout a communication
system, the system including a plurality of first type
data terminal devices, at least one first type

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communication device, a second type data communication
interface device and a data processing device
communicatively coupled to said second type data
communication interface device, the method comprising:

    generating data messages for communication from
an originating device of said communication system to a
destination device of said communication system;

    communicating any data messages generated by
said first type data terminal devices at a first
communication level to said at least one first type data
communication device;

    communicating any data messages originating from
said data processing device through said data
communication interface device and at a second
communication level to said at least one first type data
communication device;

    re-addressing data messages received by said at
least one first type data communication device to the
respective destination device; and

    communicating re-addressed data messages from
said first type data communication device at said first
communication level to the respective destination data
terminal device, and at said second communication level
through said data communication interface device to the
destination data processing device.

FIG. 1

FIG. 2
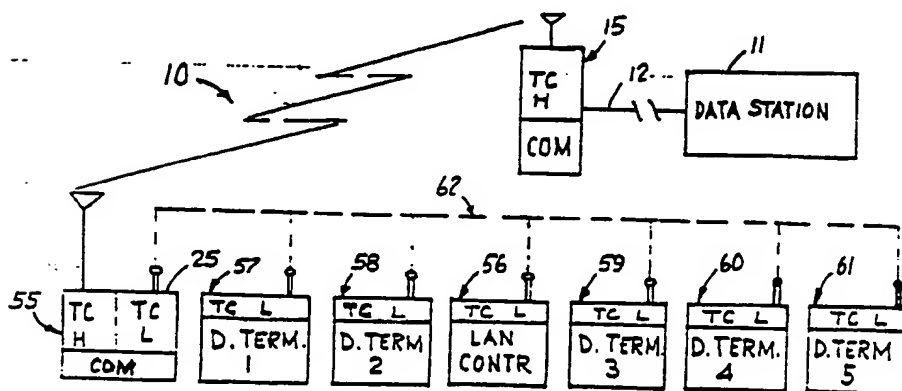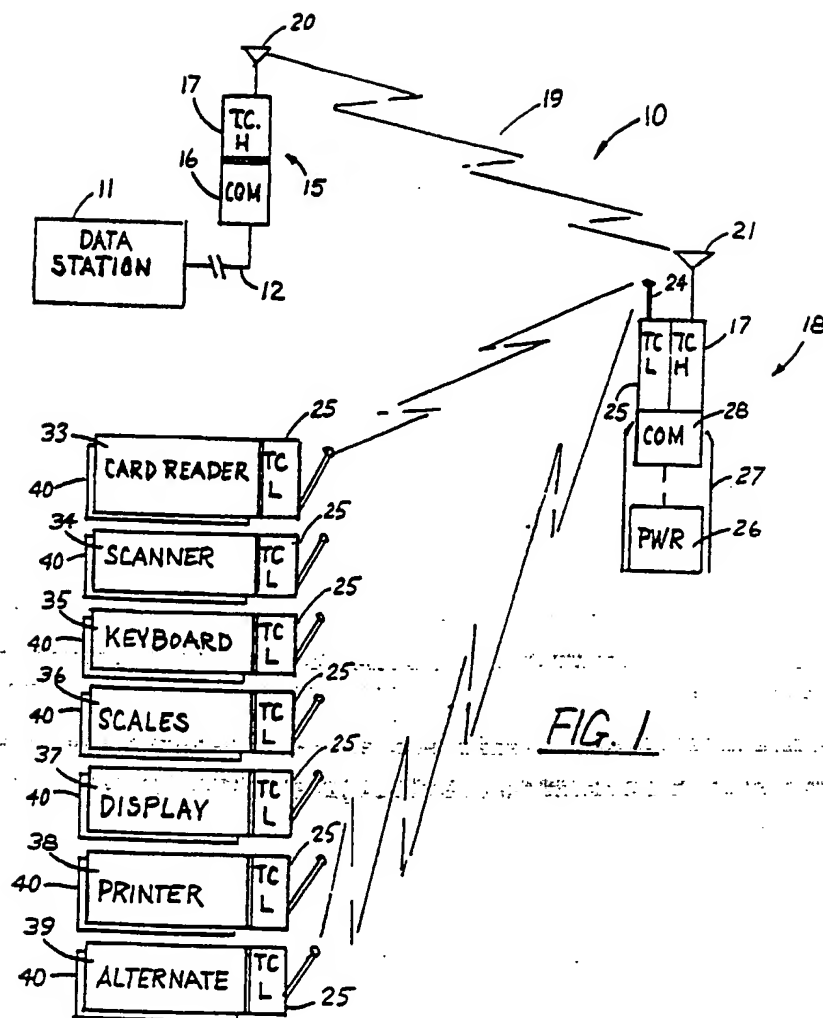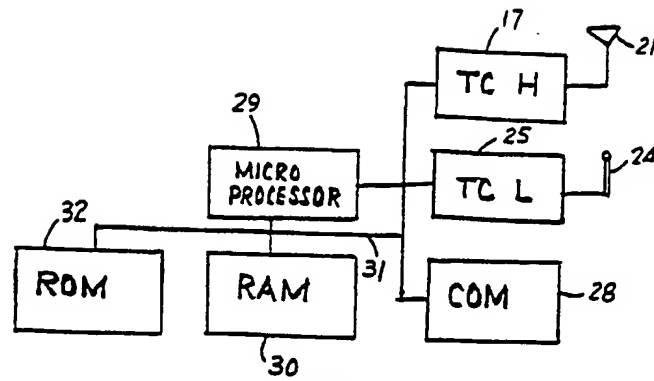
FIG. 3

FIG.4

FIG.5

FIG.7

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FIG.9

FIG.6

FIG.8
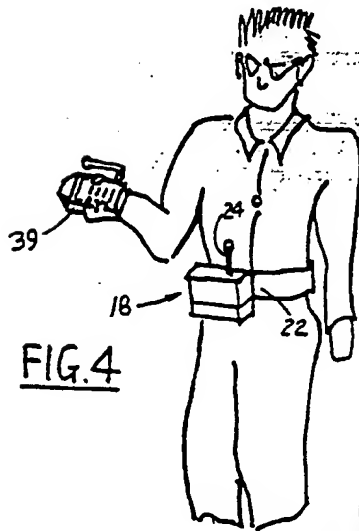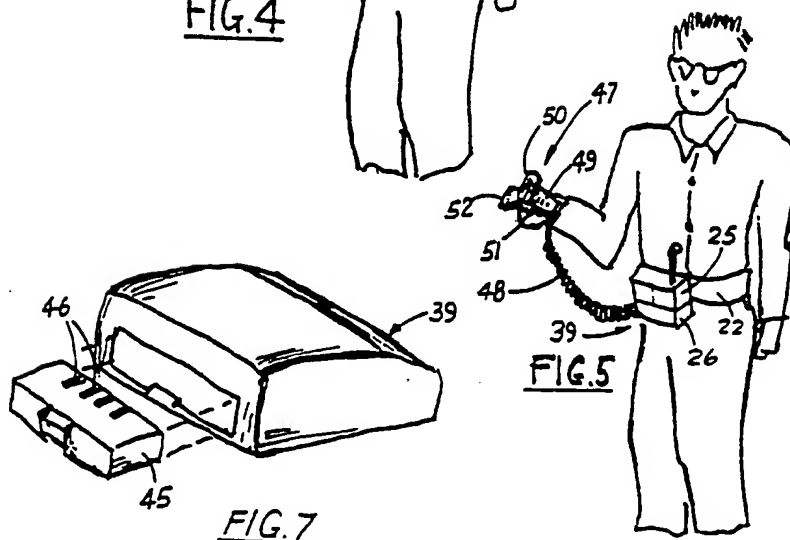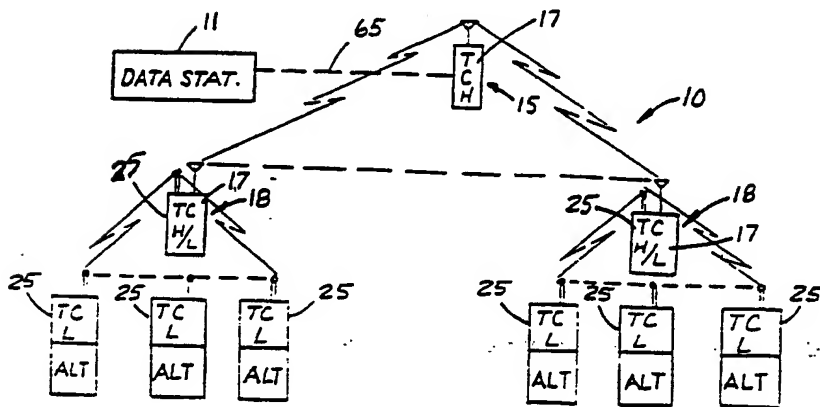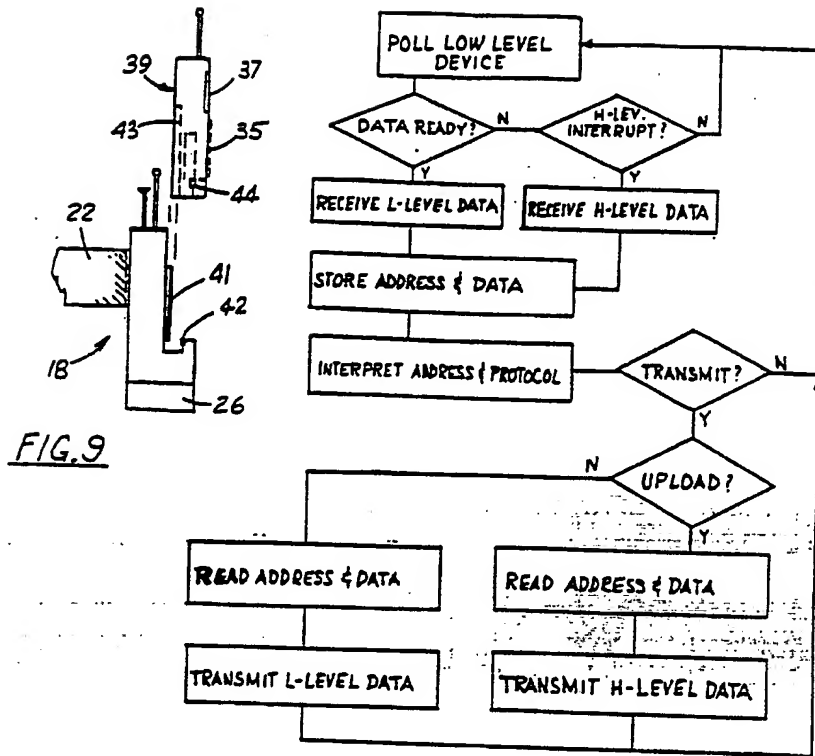
4 / 4
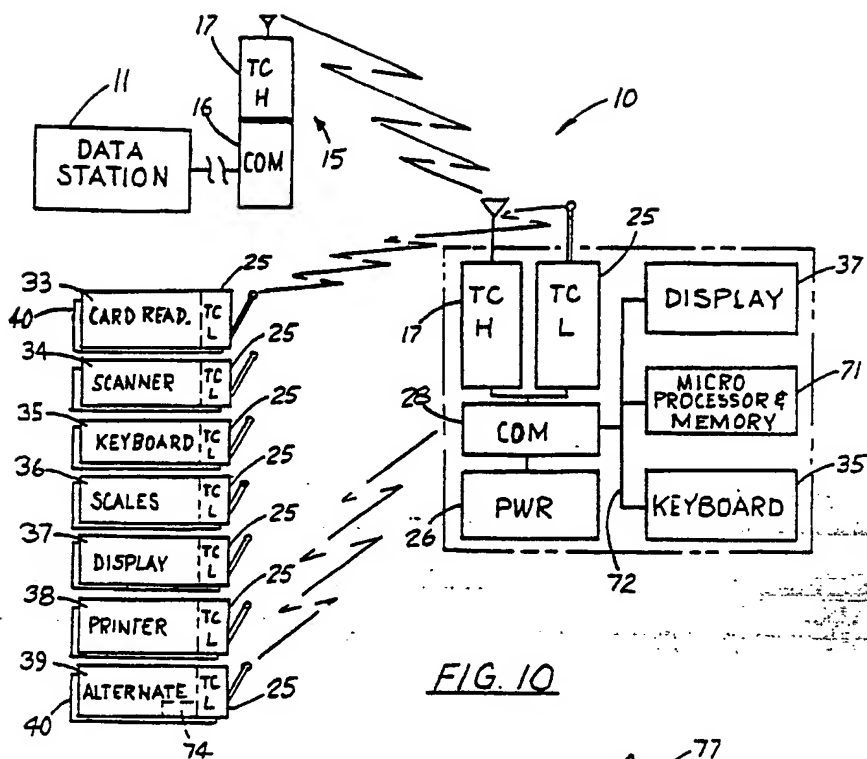
FIG. 10
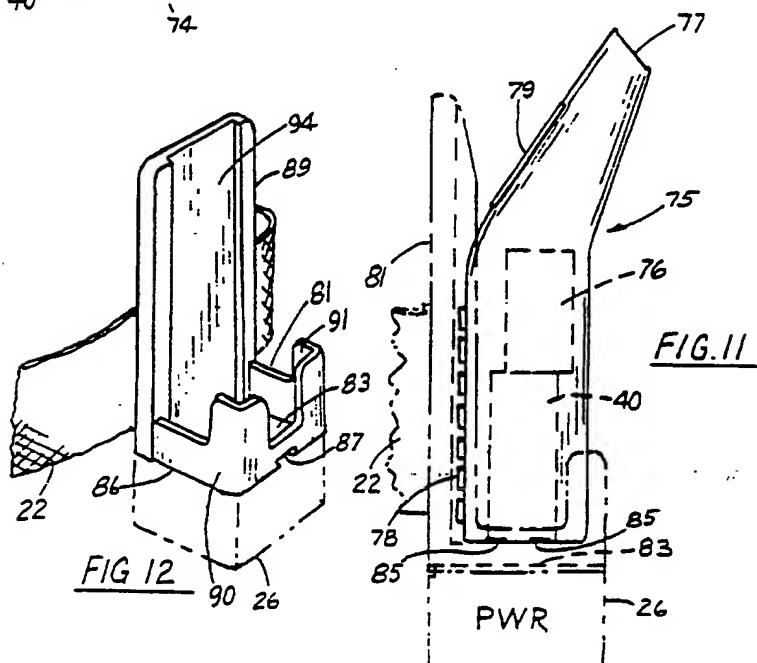
FIG 12

FIG.11

INTERNATIONAL SEARCH REPORT

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)⁶

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: H 04 B 7/15, G 07 G 1/14, G 08 C 17/00

II. FIELDS SEARCHED

Minimum Documentation Searched⁷	
Classification System	Classification Symbols
IPC5	H 04 B, G 07 G, G 06 F

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in Fields Searched⁸

III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹

Category*	Citation of Document,¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No.¹³
Y	US, A, 4539706 (D. F. MEARS ET AL) 3 September 1985, see column 4, line 40 - column 5, line 34	1,2,4,9, 10,11, 17,36, 38
Y	US, A, 4775928 (C. D. KENDALL ET AL) 4 October 1988, see column 3, line 1 - line 13	1,2,4,9, 10,11, 17,36, 38
A	EP, A2, 0280543 (NEC CORPORATION) 31 August 1988, see column 1, line 54 - column 2, line 16	1-38

* Special categories of cited documents:¹⁰

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
5th November 1991	29. 11. 91

International Searching Authority	Signature of Authorized Officer
EUROPEAN PATENT OFFICE	Natalie Weinberg

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)	
Category * Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A US, A, 4549264 (C. T. CARROLL ET AL) 22 October 1985, see column 5, line 59 - column 6, line 18 --	1-38
A WO, A1, 8808649 (MOTOROLA INC.) 3 November 1988, see the whole document --	1-38
A Patent Abstracts of Japan, Vol 12, No 152, P725, abstract of JP 63- 27969, publ 1988-02-05 SHINKO ELECTRIC CO LTD --	1-38
A GB, A, 2196766 (S PITAYANUKUL ET AL) 5 May 1988, see the whole document -- --------	1-38

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/US 91/05234

SA   50343

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on   27/09/91
The European Patent office is in no way liable for theseparticulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A- 4539706	03/09/85	NONE		
US-A- 4775928	04/10/88	FR-A-	2589598	07/05/87
		JP-A-	62106530	18/05/87
EP-A2- 0280543	31/08/88	AU-B-	599458	19/07/90
		AU-D-	1218388	01/09/88
		JP-A-	63211929	05/09/88
		US-A-	4906989	06/03/90
US-A- 4549264	22/10/85	AU-B-	585488	22/06/89
		AU-D-	3509584	23/04/85
		CA-A-	1214875	02/12/86
		EP-A-	0172833	05/03/86
		JP-T-	61500284	20/02/86
		US-A-	4658357	14/04/87
		WO-A-	85/01582	11/04/85
WO-A1- 8808649	03/11/88	AU-D-	1546188	02/12/88
		EP-A-	0360803	04/04/90
		EP-A-	0363998	18/04/90
		JP-T-	2501023	05/04/90
		US-A-	4803487	07/02/89
		US-A-	4804954	14/02/89
GB-A- 2196766	05/05/88	NONE		

For more details about this annex : see Official Journal of the European patent Office, No. 12/82

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